SHRIMP U-Pb zircon ages from Trans–Himalayan Ladakh Batholith and its exhumation using fission track zircon–apatite ages

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SHRIMP U–Pb zircon ages from the Trans–Himalayan Ladakh Batholith provide better constraint on the crystallization of this important calc–alkaline Andean–type pluton between 60.1±0.9 Ma and 58.4±1.0 Ma beneath the southern leading edge of the Eurasian Plate due to partial melting of mantle as a consequence of northward subduction of the Neo–Tethyan oceanic lithosphere. These ages have been obtained from two widely–spaced bodies–the older one from granodiorite on the northern face of the batholith along Kharu–Chang La section near Tsoltak, while slightly younger diorite phase has been dated from Igu village near Upshi. No older cores have been observed in the CL images, therefore Ladakh Batholith represents crystallization of an I–type granitoid. When these ages are analyzed with the available Rb–Sr whole rock isochron age of 60±1 Ma of the Shey granite and 60±3 Ma U–Pb zircon concordia age from Leh, it is evident that the southernmost edge of the Eurasian Plate has witnessed extensive plutonism ~60 Ma.

In addition, fission track dating of zircon and apatite has been carried out along 3 important profiles of the Ladakh Batholith: Leh–Khardung La, Kharu–Chang La and Lyoma–Hanle sections. Two zircon ages from the Chang La section are 41.73±2.28 Ma and 43.37±3.36 Ma, while one sample from Lyoma–Hanle section yields a much younger age of 31.71±2.68 Ma.

30 FT apatite samples from the Ladakh Batholith provide a very good constraint on its exhumation at low temperature (~110 °C). The oldest apatite ages have been encountered from highest uplifted parts of the batholith and are 23.07±1.10 Ma from Khardung La (5440 m), and 25.35±2.57 Ma from Chang La (5301 m), while youngest ages are 11.79±1.10 Ma (4038 m), 9.21±0.87 Ma (3732 m) in these two corresponding sections. Weighted mean FT ages from these sections are 14.93±0.32 Ma, 17.38±0.33 Ma and 14.33±0.32 Ma along Lyoma–Hanle section. Elevation profiles of the former two sections from 10 FT apatite samples each yield exhumation rates of 0.11 mm/a for Khardung La between 23 Ma and 12 Ma and 0.09 mm/a for the Chang La section between 25 Ma and 9 Ma.

SHRIMP U–Pb zircon and FT zircon and apatite data have been critically analyzed with the available and reliable other geochronological data set from the Ladakh Bahtolith to decipher its exhumation rates since its crystallization ~60 Ma. The Ladakh Batholith witnessed extremely fast exhumation of about 3.75mm/yr during 45 Ma ($^{40}Ar/^{39}Ar$ hornblende) and 42 Ma (FT zircon), which follows a moderate exhumation of 0.55 mm/yr between 60 Ma and 45 Ma. It has witnessed much slower exhumation at 0.10 mm/yr since 25 Ma.

Variable exhumation rates within the Ladakh Batholith have been interpreted due to subduction of the Indian continental lithosphere to depth of about 100 km where it had witnessed UHP metamorphism ~53 Ma and its subsequent exhumation, which has resulted in the piggy-back ride of the Ladakh Batholith to its present heights.